Vehicle Crash Testing
using the LogBook/300™

Automotive

Application Note #38

A leading original equipment manufacturer (OEM) of automobile and truck air-bag systems required an in-vehicle data acquisition system to verify crash test results. Crash testing is critical to developing reliable air-bag systems that conform to federal transportation specifications.

Application Summary

When attached to fereromagnetic material, the magnetostrictive sensor emits a signal with an amplitude in the millivolt range. When the ferromagnetic material experiences a stress, as it would during a vehicle crash, the material's magnetization changes and the output of the sensor changes. Because shock waves travel well through the vehicle's metal frame, the sensor can detect impacts from any direction that occur at a distance from the sensor.

To test the reaction time of the sensor, the OEM installs air-bag systems into vehicles and subjects them to simulated crash tests. Engineers perform many crash tests at different speeds and angles to acquire test data.

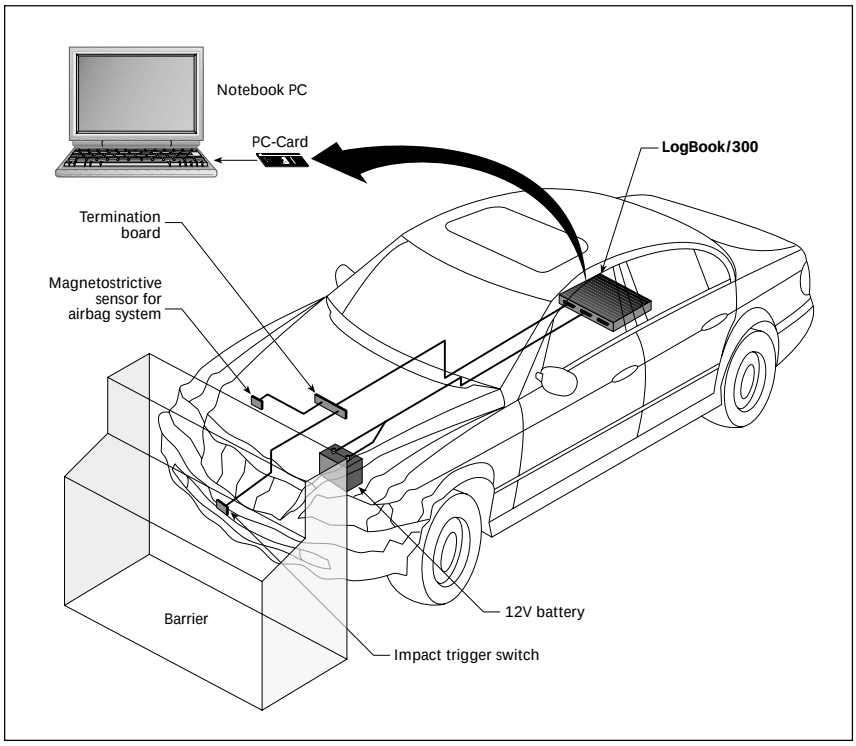
Because the beginning of the crash contains the most critical events, the engineers look to discover the precise time at which the crash occurred (time zero), and how long it took for the sensor to detect the crash. Data is collected in the 0.5s to 1s interval immediately following impact, an acquisition period which produces approximately 50,000 to 100,000 data points.

Potential Solution

The air-bag manufacturer evaluated several data acquisition systems that would quickly and easily collect the data from a high-speed vehicle crash; however, these systems were not able to withstand the g forces involved in a crash and did not meet the OEM's sampling requirement.

IOtech's Solution

Ultimately, the air-bag manufacturer selected IOtech's LogBook/300 stand-alone data acquisition system, which provided the convenience of a PC-based system without exposing the PC to potentially damaging forces. The LogBook/300's removable PC-Card (PCMCIA) permitted the data to be transferred to a benchtop PC. The card's non-volatile storage of up to 250 million samples was adequate for the sizable files of data, acquired at a rate of 100K samples/s with a resolution of 16 bits.



The LogBook/300 stand-alone data acquisition system collected data from an impact switch and air-bag sensor, storing the data on removable PC-Card memory

Two essential requirements for the data acquisition system were portability and ability to withstand the g forces encountered in a high-speed crash test. To perform a test, company technicians mounted the compact LogBook/300 chassis in the test vehicle, using twisted pair cable to connect the system to a terminal board located four to six feet away. The terminal board, in turn, was connected to the air-bag system's magnetostrictive sensor and an impact trigger switch.

The air-bag manufacturer was impressed by the LogBook/300 system's trigger programability. Contact switches or tapes placed in the test vehicle's impact area supplied the trigger signal. When the trigger signal

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the smart approach to instrumentation™

came from a simple switch, the company's engineers easily programmed the LogBook/300 to trigger on the switch closure signal — often a TTL compatible signal. IOtech's LogBook/300™ was configured to sample the magnetostrictive sensor at 100 kHz for 1 second after it was triggered by the impact trigger switch.

Moreover, the air-bag manufacturer was pleased with the LogBook/300's 20 Mbyte memory storage PC-Card. After each test, technicians remove the card from the data acquisition system, insert it into the lab's laptop computer, and quickly and easily upload the data for analysis with their analysis software of choice. LogView™ *Out-of-the-Box*™ software, a graphical data acquisition package included with the LogBook/300 system, provided an easy means to configure the application on the lab PC, without programming.

Another compelling reason for choosing the LogBook/300 was the ease of use of LogView, the included application software. The OEM needed a data logging software package that was flexible and powerful, yet did not require the help of programmers or software integrators. LogView met all of their requirements by providing a simple interface for setting up channel acquisition parameters while providing sophisticated features such as multiple sample rates, calculated channels, and dynamic outputs.

Conclusion

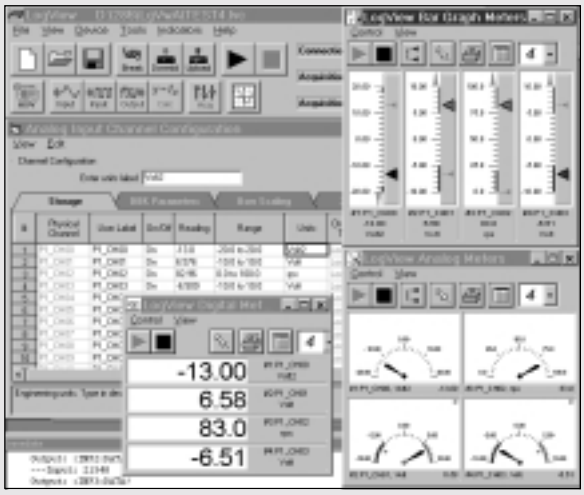
The Logbook/300 data acquisition system and included LogView software provides flexible triggering, low cost, and ease of use. With removable PC-card memory, the stand-alone Logbook/300 system can operate without an attached PC in the test platform. What's more, the system's extensive signal conditioning options for strain gages, thermocouples, accelerometers, and other signal types — combined with an optional control terminal for triggering and reviewing acquired data — make it an effective solution that outperforms other test and measurement instruments.

LogBook/300

IOtech's LogBook/300™ data acquisition system provides high speed, low cost, and ease-of-use, without requiring a PC at your test site. The intelligent LogBook/300 executes your data acquisition applications and saves acquired data using low-cost PC-Card memory. And since you don't need a PC at the test site, you save cost, space, and avoid the threat of damage or theft to your PC.

Features

- 16-bit, 100-kHz A/D converter with digital calibration
- 16-channel analog inputs — expandable up to 256 channels
- Digital I/O, frequency I/O, and analog output expandable to over 200 channels
- Non-volatile storage of up to 250 million samples via low-cost and removable PC-Card memory
- Infinite acquisition duration by swapping PC-Cards
- Direct communication with PC via serial, parallel port, or modem if desired
- Optional control terminal for triggering & reviewing acquired data
- Signal conditioning options for strain gages, thermocouples, accelerometers, and nearly every other signal type
- AC or DC powerable



LogView requires no programming or block diagram configuration

Included Software

Whether you're on a vehicle, at a remote test site, or on the factory floor, the LogBook/300 with LogView *Out-of-the-Box*™ software is the new low-cost and compact solution for collecting data. No programming skills or expensive extra software is ever required!

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Vehicle Crash Testing

The Application

A leading original equipment manufacturer (OEM) of air bag systems required an in-vehicle data acquisition system to verify crash test results. Crash data is gathered by using a magnetostrictive sensor. When a stress is experienced, as it would during a vehicle crash, magnetization alters and the output of the sensor changes signaling that impact has occurred. The OEM subjects vehicles with air-bag systems to simulated crash tests. Because the beginning of the crash contains the most critical events, engineers work to determine the precise time of the crash, and how long it takes the sensor to detect the crash. Data is collected in the 0.5s to 1s interval immediately following impact, which produces 50,000 to 100,000 data points. The manufacturer evaluated several data acquisition systems; however, these systems were not durable enough and did not meet the sampling requirement.

System Design

The manufacturer selected IOtech's LogBook/300™ stand-alone data acquisition system, which provided the convenience of a PC-based system without exposing the PC to damage. The LogBook/300's removable PC-Card (PCMCIA) permitted data transfer to a benchtop PC. To perform a test, company technicians mounted the compact LogBook in the test vehicle and connected the system to a terminal board. The terminal board was connected to the air-bag system's magnetostrictive sensor and an impact trigger switch. The engineers programmed the LogBook/300 to trigger on a switch closure signal from the impact area — often a TTL compatible signal. The LogBook was configured to sample the magnetostrictive sensor at 100 kHz for 1 second. After each test, technicians upload the data from the LogBook's 20 Mbyte PC-Card to the lab's computer. LogView™ *Out-of-the-Box*™ software provided an easy means to configure the application on the lab PC, without programming. LogView features a simple interface for setting up channel acquisition parameters while offering features such as multiple sample rates, calculated channels, and dynamic outputs.

LogBooks™
Stand-Alone Intelligent
PC-Based Data Acquisition Systems

ChipCenter's Alex Mendelsohn says the LogBook/360 is "a quintessential expression of what today's mixed-signal data acquisition can and should be."
Read the Full Review

Features

- Operates without a PC at the test site
- 16-bit, 100-kHz analog & digital sampling
- Compact yet expandable architecture can accommodate over 400 channels of analog, digital, & frequency I/O
- Stand-alone nonvolatile storage of over 250 million samples via removable PC-Card memory
- Card swapping and uploading during acquisition allows continuous data acquisition
- Communication with PC via RS-232, parallel port, modem, or by transporting a PC-Card; optional RS-422 interface
- Built-in analog inputs support 14 programmable ranges up to 20V
- Synchronous, mixed signal acquisition of analog, digital, and counter inputs
- Optional modem support provides remote communication
- Optional GPS support (model /360 only) logs location information*
- Optional control terminal provides channel inspection and acquisition queries
- AC or DC powerable

Signal Conditioning Options

- Expansion cards & modules for high-voltage/current, strain gages, thermocouples, isolation, relays, accelerometers, filtering, & simultaneous sample & hold in al

Software

- Includes LogView™ *Out-of-the-Box*™ software for easy setup, calibration, & more; no programming required
- Simple spreadsheet-style interface provides powerful setup features for immediate startup
- Acquisition configurations can be transported to the LogBook via PC-Card, serial port, parallel port, or modem connection
- Provides direct support for a wide variety of transducers
- Includes DIA*dem*®-View for post-acquisition data viewing

* Contact factory for availability

Complete Information

See complete catalog information on the LogBook data logger in PDF format (1 MB), including:

- Operating Modes
- I/O, Expansion and Signal Conditioning
- Triggering and Sampling
- Channel-Scanning Flexibility
- Remote Operation Terminal
- LogBook/Modem Features
- LogBook/GPS Features
- Included LogView Software Features
- Complete Specifications

Application Breifs

In-Vehicle Temperature Testing
An automaker tests engine temperatures under extreme operating conditions

Vehicle Crash Testing
An airbag manufacturer tests its products with a sturdy, stand-alone data acquisition system

Ordering Information

Data acquisition system including AC adapter; 2 ft. parallel port cable; 6 ft. serial cable; LogView & DIA*dem*®-View software	LogBook/300	Add to Cart
Data acquisition system with internally housed signal conditioning including serial ports; AC adapter, 2 ft. parallel port cable; 6 ft. serial cable; LogView & DIA*dem*®-View software	LogBook/360	Add to Cart
PC-Card Memory (required) 12MB solid state memory	MEMCARD12	Add to Cart
40MB solid state memory	MEMCARD40	Add to Cart
80MB solid state memory	MEMCARD80	Add to Cart
260MB rotating hard drive memory	MEMCARD260	Add to Cart

520MB rotating hard drive memory	MEMCARD520	Add to Cart
Hand-held terminal with 2 ft. cable to LogBook (no external power required)	LBK1	Add to Cart
Internal 4-channel analog output module	LBK2	Add to Cart
Panel for fastening LBK1 to top of LogBook/300	Mount1	Add to Cart
Internal DRAM 16MB internal memory option (factory installed) for LBK1	LBKMEM1	Add to Cart
16MB internal memory upgrade (field upgrade kit) for LBK1	LBKMEM1-U	Add to Cart
Interface RS-422 and RS-485 interfaces added to existing RS-232 and parallel ports	LBK/COM/422/485	Add to Cart
Modem support software and Upload Scheduler application (does not include modem)	LogBook/Modem	Add to Cart
Factory installed serial I/O board and GPS support software	LogBook/GPS	Add to Cart
Blank termination panel	DBK601	Add to Cart
16-connector BNC termination panel	DBK602	Add to Cart
16-connector red safety-jack termination panel & wiring kit	DBK603	Add to Cart
16-connector (8 pairs) red & black safety-jack termination panel & wiring kit	DBK604	Add to Cart
14-connector type B thermocouple panel & wiring kit (male thermocouple connector sold separately)	DBK605-B	Add to Cart
14-connector type J thermocouple panel & wiring kit (male thermocouple connector sold separately)	DBK605-J	Add to Cart
14-connector type K thermocouple panel & wiring kit (male thermocouple connector sold separately)	DBK605-K	Add to Cart
14-connector type R thermocouple panel & wiring kit (male thermocouple connector sold separately)	DBK605-R	Add to Cart
14-connector type S thermocouple panel & wiring kit (male thermocouple connector sold separately)	DBK605-S	Add to Cart
14-connector type T thermocouple panel & wiring kit (male thermocouple connector sold separately)	DBK605-T	Add to Cart
48-connector removable-block screw-terminal panel & wiring kit	DBK606	Add to Cart
Slotted-termination panel with adjustable clamp	DBK607	Add to Cart
Three DB37 female connector termination panel & wiring kit	DBK608	Add to Cart
Expansion cable from LogBook to DBK expansion products 2.5 in expansion cable	CA-37-1T	Add to Cart
4.5 in expansion cable	CA-37-3T	Add to Cart

5.5 in expansion cable	CA-37-4T	Add to Cart
11.5 in expansion cable	CA-37-8T	Add to Cart
Ribbon cable with female DB37 connector, provides convenient wiring to LogBook P1, P2, and P3 ports without requiring soldering to DB37 connectors, 6 ft.	CA-113	Add to Cart
5-pin male locking DIN to automobile cigarette lighter power cable, 8 ft.	CA-171	Add to Cart
Retractable cable from LBK1 to LogBook/300, 6 ft.	CA-173	Add to Cart
Shielded cable for CE compliance, from LBK1 to LogBook/300, 3 ft.	CA-174	Add to Cart